
XIII. NOTES ON THE AGRICULTURAL HISTORY OF MAIZE.

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The history of a subject is not infrequently introduced by a brief review of what there may be of prehistoric evidence. This prehistoric evidence is usually limited to the legends and archeological remains that have been left by primitive man before a written language was adopted. In the history of a cultivated plant there often is prehistoric evidence that goes back to a still earlier period. Properly interrogated, the plant itself may disclose much of its early history, which in the case of maize probably goes back to the beginnings of agriculture on the American Continent. This early evidence is naturally somewhat elusive and is open to more than one interpretation, but should not on this account be disregarded.

One bit of prehistoric evidence contributed by the maize plant itself is that maize is of American origin. Although for many years disputed, this statement may now be made with assurance. So long as the argument was confined to archeological and philological fields there was room for a reasonable doubt, although the disputants seldom admitted as much; but with the recognition of the close relationship between maize and the native American grass, *Euchlaena mexicana*, together with the complete absence of maize relatives from the Old World, the contention for an Old World origin became untenable.

Although of American origin, there are some reasons for believing that maize may have reached Asia before the time of Columbus. At one time the balance of evidence appeared in favor of this view. But a rather extensive examination of the pre-Columbian Chinese literature, made by Dr. W. T. Swingle, has failed to disclose any certain reference to maize. This, together with the evidence presented by Doctor Laufer,² leaves the burden of evidence in favor of a post-Columbian introduction. The question should still be left open; but in any case the introduction of maize into the Old

¹ Paper read before the Agricultural History Society, May 12, 1919, with slight additions.

² Laufer, B., The Introduction of Maize into Eastern Asia, Congrès International des Americanistes, 15th Session, Quebec, 1907.

World must have been long after its domestication, and it is only necessary here to insist that this question shall not obscure the fact that maize must have been domesticated in America.

Before attempting to trace the early history of maize it will be well to consider the different theories that have been advanced regarding the manner of its origin or domestication.

Viewed in relation to natural wild species, maize is a monstrosity. In any of its known forms it is quite incapable of maintaining itself without the aid of man. This fact alone removes practically all hope of discovering the wild prototype of maize. To be wild this plant would have to be very unlike maize.

Instead of possessing adaptations for distribution, the seeds are persistent on a closely packed spike and are further protected against dispersion by being surrounded by a series of long bracts or husks. The young plants are unable to compete successfully with other vegetation. Neither is maize particularly resistant to drought, alkali, cold, or excessive moisture.

All of the other cereals under favorable conditions may escape from cultivation and persist for a time unaided, but there are no records of escaped maize. These facts must be kept in mind in attempting to trace the domestication of maize.

Three general theories of the domestication of maize have been advanced. Briefly stated, these are as follows:

(1) The cultivated forms of maize are descended from pod corn, or *Zea tunicata*, which it has been claimed is a wild plant in Paraguay.

(2) Maize has been derived by gradual evolution from some plant related to teosinte (*Euchlaena mexicana* Schrad), a native Mexican grass.

(3) Maize is the result of a hybrid between teosinte and some other species of grass.

To these might be added a fourth method, which, so far as I know, has never been advocated, but which seems worthy of consideration, viz, that maize originated as a mutation or sport from teosinte or some ancestor of teosinte.

POD CORN AS THE PROGENITOR OF MAIZE.

The early accounts of maize abound in references to pod corn as a wild or primitive type of maize. The distinguishing feature of podded maize is that, in addition to the husks which cover the ear, each individual grain is completely inclosed by the glumes. Pod corn was first reported by August de Saint-Hilaire in a letter addressed to the president of the French Academy of Sciences and

published in 1829.³ The specimen presented by Saint-Hilaire consisted of a part of an ear received by him from the Abbé Larranhaga of Montevideo. It was accompanied by the statement from the abbé that this variety was cultivated by the Guaycuru Indians. This statement of Larranhaga's was questioned by Saint-Hilaire, who claimed that the Guaycurus were a wild, nonagricultural tribe. When, however, the podded ear was shown to a young Guarany Indian of Paraguay, who had accompanied Saint-Hilaire to France, this Indian recognized the specimen as from his country and said that it grew in the humid forests. Without apparent warrant, the word "wild" has crept into this quotation until there are now many statements to the effect that maize, especially podded maize, has been found growing wild in Paraguay.

That pod corn is cultivated by the Guaycuru Indians of Paraguay is further attested by Azara. This author, after describing two normal varieties, says:

As I have not had occasion to see frequently the variety of corn called "abaty-guaicurú," I presume that it is not believed to be separate from the others in quality. It is nevertheless peculiar. In effect, whereas the ear is exactly like those of the preceding varieties and has the same husks (envelopes), each grain is enveloped in minute leaves which resemble completely the large ones which envelop the whole ear.⁴

There is thus little doubt that pod corn is considered a variety in Paraguay, but there is no reason for believing that it exists as a wild plant there or anywhere else. Pod corn, as we know it, would be quite incapable of maintaining itself without cultivation. Furthermore, pod corn is known to have arisen more than once by mutation from nonpodded varieties. The long glumes of pod corn are distinctly an ancestral character, nearly all grasses having the seeds inclosed in glumes after the manner of pod corn; and although pod corn may not be considered as an ancestor of maize, the fact that it exhibits ancestral characters makes it a matter of great interest to know more of the part which it plays in the agriculture of the Indians of Paraguay.

³ *Annales des Sciences Naturelles*, Vol. 16, (1829), p. 143.

⁴ Azara, F., *Voyages dans L'Amérique Méridionale*, Vol. I, (1809), p. 146-148. The same author describes a fourth variety of corn which, if it is maize, as the author assumes, should be of great interest. He describes it as follows: "I do not remember the name given to the fourth variety of which the stalk, much more slender, is terminated—not by an ear, but like millet, with a kind of whip with second lashes ('Discipline à plusicu-
lus cordes') of which each is covered with seeds exactly like those of maize but smaller. I also am ignorant as to the particular use to which this may be applied. I know only that in boiling in fat or oil the seeds of this inflorescence burst open without separating, which results in a splendid bouquet that could be worn at night by a lady in her hair without one recognizing what it is. I have often eaten these popped grains and found them very good."

The only other reference to pod corn as a cultivated variety that has been found is that of Parker⁶ who lists pod corn as one of the varieties grown by the Iroquois in New York, the Indian name for it signifying original corn. The characters of pod corn have figured to some extent in genetic studies, but so far as we can learn pod corn has never been established as a true variety; that is, it will not come true to seed, but continues to produce a certain percentage of plants with normal ears.

TEOSINTE AND THE ORIGIN OF MAIZE.

In discussing the other theories of the origin of maize, it will be necessary to make frequent references to teosinte, the closest wild relative of maize. This plant is a tall grass unknown in the wild state outside of Mexico. It has much of the general appearance of maize. The chief difference in habit is that instead of having a single stalk or a strong central stalk surrounded by a few slender branches or suckers, the teosinte plant commonly produces numerous stalks of the same size. The tassel or staminate inflorescence is also more profusely branched and lacks the characteristic central spike of maize. There are many other minor differences but after all, teosinte is much like maize, except in its pistillate inflorescence, or the part corresponding to the ear of maize. Instead of the thick ear bearing many rows of naked seeds, the seeds of teosinte are borne on a much-branched inflorescence, the individual seeds being loosely attached to one another like strings of triangular beads. The seeds instead of being naked are deeply embedded in segments of the rachis which fall apart, each segment with its inclosed seed. In spite of these profound differences maize and teosinte hybridize freely. In fact maize is as easily and completely fertilized with teosinte pollen as it is with maize pollen. This perfect fertility between two distinct genera seems the more remarkable when it is realized that perhaps nowhere else with other plants or animals has it been possible to obtain fertile hybrids between two forms separated by such profound morphological differences.

The many resemblances between maize and teosinte, together with the fact that the two forms interbreed with perfect freedom, makes it certain that whatever the origin of maize it must be intimately associated with teosinte or some near relative of that plant. Very little is known regarding the part played by teosinte in the economy of the natives of Mexico. It is planted by the peons of Mexico as a fodder plant, but there is nothing to show that it has ever been used as human food.

⁶ Parker, A. C., Iroquois Uses of Maize and Other Food Plants. University of the State of New York, Edu. Dept. Bul. No. 482, Albany, N. Y., 1910.

The idea that maize originated from some extinct ancestor of teosinte as a result of selection operating on small variations, while more plausible than the pod corn hypothesis, seems very unlikely.

Any plant closely resembling teosinte would seem very poorly adapted to human use. The seeds are small and each seed is tightly inclosed in a horny and inedible segment of the rachis from which it can be removed only by crushing or grinding. The fragments of the rachis would be of practically the same density as the seed, and it is doubtful if the two could be separated by winnowing. Of the seeds of grasses used as human food, the nearest approach to teosinte is the seed of *Coix*, or Job's tears. The seeds of this plant, like those of teosinte, are inclosed in a hard covering. But in the varieties of *Coix* used for human food, the hardened envelope is brittle, and can easily be removed from the seed without crushing the latter. It would seem that the prototype of maize must have been at least edible in its wild and unimproved form, and this may scarcely be said of teosinte. There are hosts of wild grasses that have never been domesticated, any one of which would seem more promising material for the primitive plant breeder than teosinte.

HYBRID ORIGIN OF MAIZE.

To the writer it seems more reasonable to believe that the qualities adapting teosinte to the uses of man resulted from accidental hybridization with another species instead of being developed through selection from such an unpromising beginning.

The theory of a hybrid origin seems to reconcile the evidence that maize is undoubtedly closely related to teosinte with the equally clear evidence that many of the characters and tendencies of maize are entirely foreign to teosinte or the group of grasses to which it belongs. To argue this point would lead to a detailed discussion of morphology and genetics already presented elsewhere, that would be out of place.⁶

From studies of the comparative morphology of maize and teosinte and hybrids between these two species, it is believed that this unknown ancestor of maize must have belonged to the *Andropogoneae*, a tribe closely related to the *Maydeae*, in which maize and teosinte are placed. From the standpoint of human utilization this plant

⁶ Collins, G. N., Origin of Maize, *Jour. of Wash. Acad. of Sci.*, Vol. II, No. 21, Dec. 19, 1912.

Collins, G. N., Structure of the Maize Ear as indicated in *Zea-Euchlaena* Hybrids, *Jour. of Agri. Research*, Vol. XVII, No. 3, June 16, 1919.

See also Harshberger, J. W., Maize, a Botanical and Economic Study. Philadelphia, 1893 (cont. from *Bot. Lab. Univ. of Penna.*, Vol. I, No. 2); Harshberger, J. W., Fertile Crosses of Teosinte and Maize, *Garden & Forest*, Vol. 9, (1896), pp. 522-523; Weatherwax, Paul, The Evolution of Maize, *Bull. Torrey Club*, Vol. 45, (1918), pp. 309-342; Kempton, J. H., The Ancestry of Maize, *Jour. of the Wash. Acad. of Sci.*, Vol. IX, No. 1, Jan. 4, 1919.

must have differed from teosinte in having naked or nearly naked seeds borne on a rigid rachis. I am still hopeful that remains of this ancient food plant will be brought to light as a result of ethnological investigations.

FOSSIL MAIZE.

The earliest tangible evidence of the existence of maize is a fossil ear from Peru recently described by Dr. F. H. Knowlton, of the Geological Survey.⁷ The specimen is undoubtedly an ear of maize, and Doctor Knowlton is positive that it is an undoubted fossil whose age must be measured in thousands of years.

The specimen was not found in place, and there is nothing in its history, beyond the fact that it came from Peru, to indicate where it was first discovered. The bare fact of its existence, however, is highly significant, for if Doctor Knowlton is not entirely misled regarding the age of the fossil it is perhaps the earliest record of man's existence on the American Continent. If the beginning of maize culture meant merely the growing and harvesting of a wild plant, the discovery of the fossil remains of such a plant would not call for special comment; but, as stated above, maize could hardly have existed as a wild plant in anything even remotely resembling its present form. We must, therefore, think not only of primitive Americans as cultivating maize at the time when this fossil was formed, but we must realize also that the important changes necessary to produce or domesticate maize from wild forms must have taken place in still earlier times.

The fossil specimen is so much like existing Peruvian varieties that it throws little light on the botanical origin of maize. It shows, however, that all the important steps in the domestication and improvement of maize had been taken before this specimen became fossilized, and makes what we have accomplished in 400 years look discouragingly small. Some consolation may be derived, however, from the proof, which this fossil ear affords, of the very long time during which the Indians themselves effected little or no improvement.

Next in point of time is the evidence from the prehistoric graves of Peru and Bolivia. In these graves were found ears of maize wonderfully preserved through desiccation. With the actual ears are replicas of ears wrought in clay and used to adorn ceremonial vessels. In some of these the ear is so faithfully reproduced as to lead to the belief that they must have been formed in molds in which actual ears were used as models. These specimens show no characteristics not found in existing types, and some might even be classed

⁷ Jour. of Wash. Acad. Sci., Vol. 9, No. 5, (Mar. 4, 1919), pp. 134-136.

as belonging to present-day Peruvian or Bolivian varieties. Yet none of the examples of prehistoric maize from South America that I have seen are approximated by existing varieties in Central America, Mexico, or the United States. The specimens, therefore, afford no evidence that maize was introduced into South America from the north. It should be noted that the most striking South American type, the large-seeded maize of Cuzco, is not represented in the prehistoric series.

Ears found in the prehistoric cliff dwellings of our Southwest are similar to the types grown in that general region. In like manner charred ears from the Indian mounds of Ohio are not unlike the varieties of soft corn grown by the Indians of the Middle West. More recently maize has been found in the cysts of the basket makers by Kidder and Guernsey⁸ and in the pre-Pueblo remains of southern Colorado by Judd. I take it these represent the earliest evidence of maize within the borders of the United States, yet aside from their color, which is unlike anything known in North American varieties, they possess no characters that would differentiate them from varieties grown by the Papago, Zuñi, and Hopi Indians. Even their yellowish brown color, which resembles that of certain Bolivian varieties, may have resulted from a disintegration of the common blue aleurone and be due to their great age. Thus all prehistoric evidence indicates that the geographic distribution of types as we now find them has obtained for a very long time.

In the intensive genetic studies to which maize has been subjected in recent years many minor abnormalities, or mutations, have come to light. One of these new Mendelian characters causes the seeds to split open or pop before the ears are harvested. We had just succeeded in isolating this character into a pure strain and were experiencing the satisfaction of having discovered something new, even though it was worthless, when through the kindness of Doctor Judd, of the Bureau of Ethnology, we were permitted to examine this series of prehistoric maize ears, which he had unearthed from the pre-Pueblo ruins of Colorado. The specimens were beautifully preserved and two of the ears were perfect examples of our new Mendelian character.

None of the human remains found in America by archeologists can show records of antiquity comparable with those of the Old World. If archeologists, however, would consider cultivated plants as artifacts they might wish to revise their findings, for the plants themselves indicate that the origin of the native food plants of America may be as ancient as those of Europe, Asia, and Africa.

⁸ Kidder, A. V., and Guernsey, S. J., *Archaeological Explorations in Northeastern Arizona*. Bul. 65, Bureau of American Ethnology, (1919).

Before quitting the discussion of prehistoric maize, I wish to state my belief that in maize, the New World has given man the oldest cereal. This may appear as another instance of an enthusiast claiming great antiquity for his specialty, but before the claim is dismissed as altogether absurd, I wish to recall attention to some of the features that distinguish maize from the other cereals:

(1) Maize is the only cereal so profoundly modified that its wild prototype is unknown.

(2) Maize is the only cereal completely dependent on man for existence.

(3) Maize is the only cereal known in a fossilized condition.

(4) No other cereal compares with maize in the great diversity of its forms.

If the changes brought about since the time of the oldest prehistoric specimens that have yet been found are any criterion, the time necessary to develop from a common ancestor, the diversity that now exists must be measured geologically and not by centuries.

In all our wealth of highly developed maize varieties there is little that was not already represented in the Indian varieties at the time of the discovery. These in turn seem to have changed very little from the types represented in the earliest archeological and fossil remains.

If, with a base line several thousands of years in length, we fail to get a measurable parallax on the development of maize, it would appear to the biologist that the initial steps in the domestication of maize must have been made at a time more remote than that set by most anthropologists as the time of man's advent on the American Continent.

MAIZE AT THE TIME OF THE DISCOVERY OF AMERICA.

Before taking up the post-Columbian history of maize it may be well to review briefly the more striking similarities and differences of the types of maize that were being grown in the different parts of the American Continent.

The primary classification of maize proposed by Sturtevant is based entirely on seed characters. In dividing the varieties into flint, dent, pop, soft, and sweet, Sturtevant gave expression to differences already recognized by agriculturists. To this series the waxy maize of China has since been added. Sturtevant's class of tunicate or pod corn may be disregarded here since this class is not based on a seed character and is now recognized as a mutation that may appear in any of the other classes.

Many writers on maize assume that this classification, based on the texture of the seed, is fundamental and natural, with certain

ear and plant characters associated with each class. This is not true. Seed texture is no more fundamental than ear and plant characters. The shape of the seed, the number of the rows, or the habit of the plant might be used with equal propriety as a basis for arranging the varieties into types. There is, furthermore, little or no agreement in the results obtained by the use of these different criteria, and none of them give results that correspond with the geographical distribution of varieties. Flint varieties are found throughout the entire range of the species, as are eight-rowed varieties and varieties with long and slender ears. It is, therefore, futile to attempt to define the range of flint, dent, soft, or sweet varieties as such.

Certain combinations of characters, however, are peculiar to certain regions. The wide-seeded, eight-rowed, flint varieties with slender stalks and numerous suckers are practically confined to the northern and eastern parts of the United States. Varieties differing from these only by the substitution of soft for the flint type of seeds are common among the Indian tribes of the Missouri Valley and south to the Mexican border. Many-rowed, round-seeded, soft, and slightly dented varieties are common in the Southwest. Many-rowed, round-seeded, flint varieties with large culms and few suckers are found throughout the lowland Tropics. Ten and 12-rowed soft varieties with long pointed seed are characteristic of the highlands of Bolivia. Eight-rowed varieties so common in the United States are practically absent in Mexico, but appear again in the large soft-seeded Cuzco varieties of Peru.

Amid this great diversity and extreme freedom of recombinations, it is difficult to form any general views of relationship and probable migrations. But since it is becoming increasingly difficult to unravel the mixtures resulting from the interchange of seed, it may be permissible to hazard a few guesses and question some of the existing theories. It has been suggested that maize in the eastern part of the United States came from the West Indies. The varieties found in those regions afford no evidence in support of this view. The New England flints appear most closely related to the eight-rowed soft varieties of the Missouri Valley. This relationship may indicate that the New England flints were derived from the soft type of the Middle West or that the eight-rowed soft varieties have resulted from a mixing of the New England flints and the more southern soft varieties.

Neither can the West Indies be considered as a center of distribution to the west, since in passing down the Mississippi and around the Gulf to Florida and the West Indies the importance of maize decreases rather than increases, as one would expect were the West Indies to be considered as a source.

EARLY ACCOUNTS OF MAIZE.

The first definite date in the history of maize is November 5, 1492. On this day maize was first brought to the attention of Columbus. Apparently maize had not been met with in the smaller islands or on the coast of Cuba, and was first encountered by two Spaniards sent by Columbus to the interior of Cuba to learn something of what the country produced. They left the coast on October 28 and returned on November 5. One is rather disappointed at the apparent lack of interest which this novel plant created. After mentioning a kind of root, probably cassava, and a species of beans it is remarked that some of the ground was sown with "a sort of grain they call maiz, which was well tasted, bak'd, dry'd, and made into flour."⁹

The earliest printed reference to maize which I have found is in the *Decades of Peter Martyr*,¹⁰ said to have been first printed in 1511. The reference as it appears in Eden's translation, 1555, is as follows:

They make also an other kynde of breade of a certayne pulse called *Panicum*, muche lyke unto wheate, whereof is great plentie in the dukedom of Mylane, Spayne, and Granatum. But that of this countrey is longer by a spanne, somewhat sharpe towards the ende, and as bygge as a mannes arme in the brawne: The graynes whereof are sette in a maruelous order and are in fourme somewhat lyke a pease. While they be soure and unripe, they are white; but when they are ripe they be very blacke. When they are broken, they be whyter than snowe. This kynde of grayne, they call *Maizium*.

The accurate observation regarding the late stage at which the color of the seed develops, stamps the description as truthful, but unless the early explorers were much less muscular than has been supposed we are compelled to believe that the size of the ear was somewhat exaggerated.

To canvass the works of Columbus, and those in which he is cited as authority, for references to maize, would of itself be an undertaking of some magnitude, and it has not been attempted. Columbus refers to the plant as growing in Cuba, Santo Domingo, Trinidad, and the mainland of South America, but in view of the numerous descriptions of plants and animals given by Columbus, the significant fact would seem to be that he made such slight and infrequent reference to this plant, which must have appealed to a European as a striking novelty. It seems clear that the principal food plant in this part of the world was cassava, with maize occupying a

⁹ Churchill's *Voyages*, Vol. 11, (London, 1732), p. 533.

¹⁰ The *Decades of the Newe Worlde or West India*. Written in the Latine tonnge by Peter Martyr of Angleria, and translated into Englysshe by Rycharde Eden. (London 1555). In Arber, Edward. *The first three English Books on America* (Birmingham 1885), p. 67.

secondary position. Thus Dr. Chanca,¹¹ who accompanied Columbus on his second voyage and who wrote from Haiti in 1494, makes no mention of maize, although the food of the natives is described in some detail.

MAIZE AND THE EARLY COLONISTS.

With both the Jamestown and the Plymouth colonies, starvation was averted by virtue of maize, and in both settlements the colonists learned from the natives how to grow this new food plant.

The Puritans appear to have been the more apt pupils and to have made more intimate contacts with the natives. It would also appear that the agriculture of the New England Indians was of a more advanced type than that of the Indians of Virginia. At any rate our agricultural practices seem to have been derived from New England rather than from Virginia. We are told in Mourt's Relation how the first party landing on Cape Cod under the leadership of Miles Standish found fields where maize had grown, this being in November. A little farther they found newly made mounds of earth. In one of these which they opened they found—

a little old basket, full of fair Indian corn; and digged further, and found a fine great new basket, full of very fair corn of this year, with some six and thirty goodly ears of corn, some yellow, and some red, and others mixed with blue, which was a very goodly sight.¹²

With the maize they found a large kettle, and the eagerness with which this maize was appropriated is indicated by the following:

* * * We were in suspense what to do with it and the kettle; and at length, after much consultation, we concluded to take the kettle, and as much of the corn as we could carry away with us; and when our shallop came, if we could find any of the people, and come to parley with them, we would give them the kettle again, and satisfy them for their corn. So we took all the ears, and put a good deal of the loose corn in the kettle, for two men to bring away on a staff. Besides, they that could put any into their pockets, filled the same. The rest, we buried again; for we were so laden with armor that we could carry no more * * *

After securing the first prize, they later returned for more. The same account on page 141 says:

* * * This done, we marched to the place where we had the corn formerly, which place we called Cornhill; and digged and found the rest, of which we were very glad. We also digged in a place a little further off, and found a bottle of oil. We went to another place, which we had seen before, and digged and found more corn, viz., two or three baskets full of Indian wheat, and a bag of beans, with a good many of fair wheat¹³ ears. Whilst some of us

¹¹ The Letters of Dr. Diego Alvarez Chanca. Translated by A. M. Fernandez de Ybana. Smithsonian Miscellaneous Collections, Vol. 48, part 4, (1907).

¹² Young, A., *Chronicles of the Pilgrim Fathers of the Colony of Plymouth, from 1602 to 1625.* (Boston, 1841), p. 133.

¹³ The reference to "Indian wheat" doubtless applies to maize.

were digging up this some others found another heap of corn, which they digged up also; so as we had in all about ten bushels, which will serve us sufficiently for seed. And sure it was God's good providence that we found this corn, for else we know not how we should have done; for we knew not how we should find or meet with any of the Indians except it be to do us a mischief.

MAIZE CULTURES OF THE INDIANS.

The early colonists came well supplied with seeds of European crops, yet at both Jamestown and Plymouth they were able to become self-supporting only by promptly adopting maize and following the Indian method of cultivation, a method of cultivation radically different from anything known to the colonists.

Maize is usually thought of as differing from the principal European crops by being intertilled, but is this the most important difference? The Indians grew their crop without the aid of animals and relied on hoeing to suppress the competition of weeds. This method was practicable only with plants large enough to be given individual attention. Wheat must be treated en masse, as it were, but a maize plant may be given individual consideration. Was it not the large size of the individual plant, obviating the necessity of plowing, that really distinguished American from European agriculture? Maize, cassava, and the potato, the three great food plants contributed by America, are all grown as individual plants, while few of the important European annuals can be so treated.

It is difficult to understand how the colonists expected to produce wheat and other small grains without the aid of draft animals, yet the Plymouth colonists did not have cattle until 1624. Edward Winslow,¹⁴ writing in 1621, says:

I never in my life remember a more seasonable year than we have here enjoyed; and if we have once but kine, horses, and sheep, I make no question but men might live as contented here as in any part of the world.

It was Winslow himself who first introduced cattle, in 1624.¹⁵

Indian agriculture is commonly thought of as having been of a very temporary character, the tribes, except in the Southwest, being

¹⁴ Young, Alexander, *Chronicles of the Pilgrim Fathers* (Boston, 1841), p. 233.

¹⁵ It would appear that to Bradford and Winslow we owe practically all of the detailed information regarding the early days of the Plymouth colony. The most complete account of the first landing is found in Mourt's Relation which in Young's *Chronicles* is credited to Bradford and Winslow. Certainly this part of William Bradford's history agrees very closely with Mourt's Relation, though many passages are omitted. There are, however, numerous minor changes in the language and in a few instances additions. Mourt's Relation was first published in 1622 and reprinted without omissions in Young's *Chronicles of the Pilgrim Fathers of the Colony of Plymouth* in 1841. Although parts of William Bradford's manuscript were used by early writers, no part of it was published, as such, until a portion found by Young in Plymouth was published in 1841. By a happy series of accidents the complete manuscript was subsequently discovered in London and published by Dean in the collections of the Massachusetts Historical Society, Vol. III of the Fourth Series, (1856).

nomadic. The early accounts indicate, however, that nomadic tribes living by the chase were the exception rather than the rule, and that permanent agriculture existed in nearly all parts of the United States. G. F. Will, a student of maize culture among the Mandan Indians, makes the pertinent remark that Indian agriculture declined with the advent of the horse, which made the buffalo a much larger contributor of food.¹⁶

Unlike the primitive tribes of the American Tropics, who abandon a field after growing one crop, the fields in which maize was grown by the more northern tribes were used year after year. This practice had evidently continued in some localities until the fertility of the soil became impaired and the use of artificial fertilizers had been adopted.

When the first white settlers reached America they found maize being grown over practically the same range of territory as that in which it is now cultivated.

All the recognized seed types of maize, with the exception of the comparatively unimportant waxy maize recently discovered in China, were being grown by the American Indians at the time of the discovery. It may even be said that in the four and a quarter centuries during which the white race has been growing maize almost nothing has been produced that can not be duplicated among the cultures of the aborigines. The most highly developed varieties of the flint, flour, pop, and sweet types are little if any superior to individual types in native cultures, the chief advance having been toward uniformity. The dent varieties of the West and South represent the widest departure from the Indian types. No variety of maize now grown by the Indians, and not under the suspicion of having been secured from the white man, approximates the more highly developed dent varieties.

There is, however, direct evidence that the Indians of Virginia had originally a variety of maize of a pronounced dent type. In Beverley's History of Virginia four sorts of Indian corn are described, two early and two late varieties. Of the late variety he says:

The late Ripe Corn is diversify'd by the Shape of the Grain only, without any Respect to the accidental Differences in Color, some being blue, some red, some yellow, some white, and some streak'd. That therefore which makes the Distinction, is the Plumpness or Shrivelling of the Grain; the one looks as smooth and as full as the early ripe Corn, and this they call Flint-Corn; the other has a larger Grain, and looks shrivell'd, with a Dent on the Back of the Grain as if it had never come to Perfection; and this they call She-Corn.¹⁷

¹⁶ Atkinson, Alfred, and Wilson, M. L., *Corn in Montana*, Mont. Agri. Exp. Sta. Bul. 107, (1915), p. 36.

¹⁷ Beverley, Robert, *History of Virginia*, (London, 1722), pp. 126-127. I am indebted to Mr. Lyman Carrier for this reference.

This description would appear to establish the fact that true dent varieties were grown by the Indians, but since they have not been preserved it is impossible to judge of their quality or exact nature.

Although possessed of all of the seed types we now recognize, the seed types, with the exception of the sweet varieties, were not distinguished by the Indians as such. Their varietal names usually apply to more minute subdivisions, frequently referring to the color of the seed.

It is interesting to note that sweet corn, which genetic investigations indicate to be of comparatively recent origin, is the youngest of the seven corn sisters in the Zuñi mythology.¹⁸

Although widely distributed among the Indians, sweet varieties seem not to have been especially prized for eating in the green state. Will and Hyde say: "The upper Missouri Indians rarely picked the true sweet corn while green, but permitted it to ripen."¹⁹ The Papago Indians, who possess a rather extensive series of varieties, told me the same. Their sweet variety was considered a fine sort for making meal, but was not especially prized as green corn.

Unfortunately, the Spaniards were not such apt pupils of the Indians as were the settlers of Virginia and New England, and it is from the eastern tribes, representing only the outer fringe of aboriginal maize culture, that we have derived our varieties and agricultural practices.

Had the Spaniards made such intimate contacts with the Indians of Mexico and of the Southwest as did the Puritans with the Indians of New England, our knowledge of maize culture would have proceeded much more rapidly. In Mexico and the southwestern part of the United States maize culture was highly developed. The specialization of types adapted to different environmental conditions, discrimination in the use of varieties for food, and agricultural practices were all much more highly developed than in the East. Much of the knowledge possessed by these primitive cultivators, as well as valuable types, have doubtless been lost, and it is only in recent years that we have regained in some measure the attitude of our forefathers by realizing that the Indians' long acquaintance with maize has produced results worthy of our serious consideration.

It is a commonplace remark that maize is the gift of the Indian. But the extent to which the details of agricultural practices have been copied from the Indian has never been fully appreciated. Perhaps copied is not the right word, for in more than one instance a

¹⁸ Cushing, F. H., *Zuñi Breadstuff*, *The Millstone*, Vol. IX, No. 1, (Indianapolis, June, 1884), p. 3.

¹⁹ Will, G. F., and Hyde, G. E., *Corn Among the Indians of the Upper Missouri*, (Saint Louis, 1917), p. 117.

new practice has been adopted without knowing that the same ground had been traversed long before by the Indian.

From their Indian friend, Squanto, the Plymouth colonists learned among other things that they should catch fish with which to fertilize the ground. We learn from a letter written by Edwin Winslow, dated December 11, 1621, that the colonists had planted some 20 acres to maize the preceding season, all manured with fish. Regarding this use of fish, Morton says:

There is a fish, by some called shads, by some allizes, that at the spring of the year pass up the rivers to spawn in the ponds; and are taken in such multitudes in every river that hath a pond at the end, that the inhabitants dung their ground with them. You may see in one township a hundred acres together set with these fish, every acre taking a thousand of them; and an acre thus dressed will produce and yield so much corn as three acres without fish.²⁰

The growing of maize as individual plants instead of by the European system of broadcasting or growing in rows has already been referred to. The number of seeds planted in a hill has not been changed from the practice of the Indians. The importance of regulating the number of seed in accordance with the distance between the hills and the fertility of the soil was also appreciated by the Indians.

Even the separation of the seeds in the hill that has only recently been advocated²¹ was practiced by the Indians of Virginia, and was described in 1585 by Hariot in the following words:

* * * beginning in one corner of the plot, with a pecker, they make a hole, wherein they put foure graines with that care they touch not one another, (about an inch asunder)²²

Flint says:

The custom of hillling corn was derived from the Indians, who planted it so, and even occupied the same hills or mounds year after year successively, raising three clusters of stalks on each large hill, and scraping fresh soil upon them, so that they remain to our day. The similar cultivation now even sometimes followed is called planting in Indian Hills.²³

We have since abandoned the Indian practice of hillling maize as less advantageous than flat culture. It is just possible, however, that we have to some extent missed the point. The large permanent

²⁰ Young, Alexander, *Chronicles of the Pilgrim Fathers of the Colony of Plymouth, from 1602.* (Boston, 1841), p. 231, footnote.

²¹ Hartley, C. P., *A More Profitable Corn-Planting Method*, U. S. Dept. of Agriculture, Farmers' Bulletin 400, May 27, 1910.

²² Hariot, Thomas, *Narrative of the First English Plantations of Virginia*, (London, 1590), pp. 23-24.

²³ Flint, C. L., *Agriculture of Massachusetts*, (1859), p. 84, *Sixth Ann. Report, Mass. Board of Agriculture*.

hills used by the Indians would not be subject to most of the objections to the temporary hill system and may have decided advantages, especially where maize was grown without plowing.

Dr. W. E. Safford has called my attention to the Indian practice of preserving green corn by packing it in pits from which the air was excluded. Thus the silo, which is frequently pointed out as the most important advance in the utilization of maize, was definitely foreshadowed by Indian practice.

Although Indian varieties are usually much mixed there is abundant evidence that they appreciated the importance of pure cultures. Will is authority for the statement that the Mandans kept no less than 13 varieties of maize pure by means of isolated plantings.

Among the Navajo Indians there is a very distinct variety that shows through breeding experiments that it is uncontaminated by other sorts. Inquiry among the Navajos developed the fact that this variety was in the custody of one Indian, Lone Cedar Tree, who received the variety from his father. A peculiar color pattern which has recently figured in genetic literature is derived entirely from this variety and owes its preservation in a pure state to this one Indian.

In addition to the isolation of particular strains by the Indians, which in recent years at least is largely for ceremonial reasons, choice of the best appearing ears for seed was a general practice, especially among the more agricultural tribes.

The various colors exhibited in the seeds of maize and which play such an important part in the maize ceremonies of the Indians were in some tribes kept pure by assigning each of the colors to an individual who was charged with maintaining the stock by planting selected seed in isolated localities. The Indians, however, did not make the mistake committed by our early maize breeders of applying a system of close breeding. Maize is a cross-pollinated species, and rapidly deteriorates when self-pollinated. The converse of this deterioration, that is, the additional vigor obtained by crossing distinct strains, was foreshadowed in the Indian practice of deliberately planting seeds of different colors in the same hill. It is not to be understood that the Indians maintained pure strains, took advantage of the vigor that follows crossing, practiced seed selection, and performed the many agricultural practices which have since been laboriously developed by the white man, for any such reasons as are now assigned. The Indian nearly always has a reason for what he does, but it seems never to have been what we now believe to be the true reason. That he adopted so many methods and practices for

which justification has since been found should be looked upon as the result of the working of a kind of natural or unconscious selection.

As with more civilized agriculturalists, he was sometimes governed more by the logic of his theory than by practical results. Thus the Zuñi Indians went to great trouble to distribute the spores of corn smut in their fields. In thus spreading a serious disease, they were possessed by the theory that the spores of corn smut were the fertilizing agent of corn. It seems not impossible that they dimly sensed the function of pollen, and confused this with the spores of smut. On the other hand they may have been unconsciously impressed with the fact that a smutted corn plant is frequently larger and more vigorous than its disease-free neighbors.

In utilizing the great diversity of types in the preparation of different kinds of food, we are still far behind the Indians. We have but two kinds of corn meal, yellow, and white. The Indians carried the specialization much further. In Mexico especially, particular varieties are preferred for almost every dish or method of preparation.

With such a wealth of diversity it is difficult to understand why we have limited our discrimination to such an unimportant and ephemeral character as endosperm color.

The colonists who at first adopted maize to avoid starvation soon learned to prize it even in comparison with the longer-known cereals. After two or three generations, it came to be recognized as a national food, pined for by Americans forced to reside abroad. After a long residence in France, deprived of this native food, Joel Barlow was so moved by the kindness of his host in providing a dish of corn-meal mush, that he became inspired to write his epic, *The Hasty Pudding*.²⁴ Many were impelled by a missionary spirit to enlighten their cousins in the Old World regarding the virtues of this new food. Prominent in this work were Henry Coleman and Dr. John Bartlett. The latter in a letter addressed to Lord Ashburton presented the case as follows:

First. That the laboring classes and the poor of Great Britain require a cheaper article of food than wheaten bread.

Second. That although wheat contains a larger portion of gluten, or the nutritive ingredient, bulk is necessary, not only to satisfy the craving of hunger, but to promote digestion by the "stimulus of distension," which bulk alone can give.

Third. That the craving of hunger being removed or alleviated by the quantity taken, the mind is more at ease; the mental irritability consequent upon hunger is assuaged, and man goes to his labor with cheerfulness and vivacity, becoming a more peaceful citizen and perhaps a better man.²⁵

²⁴ Barlow, Joel, *The Hasty Pudding*, Harper's New Monthly Magazine, (July, 1856), pp. 145-160.

²⁵ Browne, D. J., *American Institute Report, 1846* (Albany, 1847), p. 419.

A somewhat less utilitarian appeal is made by Elihu Burritt, better known as the "learned blacksmith," who made a pedestrian tour of Europe spreading the gospel of maize. In one of his letters he says:

I have just got out "An Olive Leaf, from the Housewives of America to the Housewives of Great Britain and Ireland, or Recipes for making Various Articles of Food, of Indian Corn Meal" containing all the recipes I received before leaving home from our kind female friends in different parts of the Union—heaven bless them! I have had 2,000 of these Olive Leaves struck off, and intended in the first place, to send a copy to every newspaper in the realm. I shall have a thousand, all of which I shall put in the hands of those I meet on the road. I have resolved to make it a condition upon which only I consent to be any man's guest, that his wife shall serve up a johnny-cake for breakfast, or an Indian pudding for dinner. I was invited yesterday to a tea party which comes off to-night, where about thirty persons are to be present. I accepted the invitation with the johnny-cake clause, which was readily agreed to by all parties. So to-night the virtues of corn meal will be tested by some of the very best livers in Birmingham.²⁸

If we may believe Thomas Carlyle, the efforts of the "learned blacksmith" were not of an intensely practical nature. Carlyle, in writing to Emerson, refers to him as follows:

Elihu Burritt had a string of recipes that went through all newspapers three years ago; but never sang there oracle of longer ears than that,—totally destitute of practical significance to any creature here.²⁹

Carlyle had been experimenting with Indian meal, and, finding it "nigh uneatable," appealed to Emerson for help and for direction as to how to prepare it. Emerson rose to the occasion, and in a letter acknowledging the receipt of a shipment of corn from Emerson, Carlyle says:

Still more interesting is the barrel of genuine Corn ears,—Indian Cobs of edible grain, from the Barn of Emerson himself! It came all safe and right, according to your charitable program; without cost or trouble to us of any kind; not without curious interest and satisfaction! The recipes contained in the precedent letter, duly weighed by the competent jury of housewives (at least by my own Wife and Lady Ashburton), were judged to be of decided promise, reasonable-looking to every one of them, and now that the stuff itself is come, I am happy to assure you that it forms a new epoch for us all in the Maize department; we find the grain sweet, among the sweetest, with a touch even of the taste of nuts in it, and confess with contrition that properly we have never tasted Indian corn before.

It is really a small contribution towards World-History, this small act of yours and ours; there is no doubt to me, now that I taste the real grain, but all Europe will henceforth have to rely more and more upon your Western Valleys and this article. How beautiful to think of lean tough Yankee settlers,

²⁸ American Institute Report (1848), pp. 420 to 421.

²⁹ Carlyle-Emerson Correspondence, edited by Charles Eliot Norton, Vol. II (Boston, 1883), p. 170.

tough as gutta-percha, with most *occult* unsubduable fire in their belly, steering over the Western Mountains, to annihilate the jungle, and bring bacon and corn out of it for the Posterity of Adam! The Pigs in about a year eat up all the rattlesnakes for miles round; a most judicious function on the part of the Pigs. Behind the Pigs comes Jonathan with his all-conquering plowshare,—glory to him, too! Oh, if we were not a set of Cant-ridden blockheads, there is no *Myth* of Athene or Herakles equal to this *fact*:—which I suppose *will* find its real “Poets” some day or other; when once the Greek, Semitic, and multifarious other Cobwebs are swept away a little²⁸

Time has shown that Carlyle was rather too optimistic. Europe has never learned to appreciate maize as an article of diet. Had there been successors to Burritt, Barlow, Carlyle, and Emerson, we might have avoided the crisis that arose during the war when it was necessary to resort to heroic measures to produce wheat to keep Europe from starvation, because Europe was unfamiliar with maize.

²⁸ Op. cit., pp. 175-177.